ESO # 1529

A SYNTHESIS OF U.S. MONETARY AND EXCHANGE RATE POLICY AND COMPETITION IN THE WORLD SOYBEAN MARKET

by

Tsorng-Chyi Hwang*

Cameron S. Thraen

Donald W. Larson

Tsorng-Chyi Hwang is Graduate Research Associate, Cameron S. Thraen is Associate Professor, and Donald W. Larson is Professor in the Department of Agricultural Economics and Rural Sociology at The Ohio State University.

Paper prepared for presentation at the Grain Marketing Symposium, sponsored by the North Central Grain Marketing Project (NC-186), Minneapolis, Minnesota, October 20, 1988.

A SYNTHESIS OF U.S. MONETARY AND EXCHANGE RATE POLICY AND COMPETITION IN THE WORLD SOYBEAN MARKET

Tsorng-Chyi Hwang, Cameron S. Thraen, and Donald W. Larson
Department of Agricultural Economics & Rural Sociology at the Ohio State University

Introduction

The linkage between macroeconomic policies and agricultural commodity trade has become an important research issue of agricultural economists (Schuh, Chambers, Chambers and Just). An area of recent focus in this research debate has been the effects of U.S. monetary policy on the volatility of agricultural commodity prices and export trade. In defining this research the linkage between two structural relationships is paramount: i) the effects of U.S. monetary growth on the agricultural commodity trade-weighted exchange rate, and ii) the responsiveness of agricultural commodity prices and U.S. exports to exchange rate movements.

Much of the current empirical work in this area has focused on one or the other of these two relationships. In the first case, Batten and Belongia (1983, 1985) provide evidence of a low correlation coefficient between the real trade-weighted exchange rate and U.S. monetary growth in the long run. In the second case, Jabara and Schwartz (1987) conclude that an asymmetry exists in exchange rate pass-through for agricultural commodities traded with Japan during the early 1980's.

Additional studies provide evidence of a significant link between real exchange rates and agricultural prices and exports, such as Chambers and Just (1981), Longmire and Morey (1983), Batten and Belongia (1985) and Haley (1986). Batten and Belongia (1983) suggest that the effects of real income changes in importing countries dominate that of the real exchange rate on U.S. agricultural exports. Collins et. al. conclude that exchange rate movements have little effect on the variability of real commodity prices.

Research which does link the two relationships together is reported by Chambers and Just (1982) and Batten and Belongia (1985). Chambers and Just conclude that U.S. farm export performance is closely linked to U.S. money supply (M2). Batten and Belongia conclude that there is a low correlation coefficient between the real trade-weighted exchange rate and U.S. monetary growth. Thus, this weak relationship breaks down the linkage between U.S. monetary growth and agricultural prices and exports in the world market.

This paper investigates the effects of U.S. monetary growth on U.S. export competition with Brazil and Argentina through trade-weighted exchange rates in the world soybean market. A monetary approach to the determination of the exchange rate is adopted as the basis for analysis. A trade-competition model is built to explore the existing soybean structure in the world market. Finally, the elasticities of world prices, exports, and imports with respect to U.S. monetary growth rate are formulated and calculated.

Background on World Soybean Trade

Exports comprise an important component of U.S. farm income for soybeans and soybean products. Major competitors of the U.S. in the world soybean market are Brazil and Argentina. Major importers of soybeans and soybean products are the European Community (EC-12) and Japan. Table 1 indicates the world market shares of exports over the period 1965 - 85. Table 2 lists the export shares of the U.S., Brazil, and Argentina to the EC-12 and Japan, 1965 - 85.

In the world export of soybeans, Brazil and Argentina increased export competition significantly in the early 1970's (Table 1). The drought years of 1978 and 1979 reduced the exports of Brazil and Argentina. The competition of U.S. soybean exports became stronger in the 1980s than that in the 1970s.

The demand for soybeans is derived from the demand for soybean meal and oil. In the world soymeal market, Brazil and Argentina became a major influence in the market in 1977 (Table 1). Since 1980, U.S. soymeal exports have been declining. The U.S. market share fell from 69% in 1967 to 20% in 1985.

In the world soyoil market, U.S. exports held the largest market share during the period 1965 - 80 (Table 1). Since 1981, Brazil and Argentina have become larger exporters of soyoil than the U.S..

The U.S. continues as the largest exporter of soybeans to the EC-12 and Japan; however, the U.S. market share has declined steadily since 1982 (Table 2). The U.S. has experienced an even greater decline in the soymeal export market share to these countries over this same period.

A Monetary-Trade Competition Model

The theory of the monetary approach to exchange rate determination developed by Frenkel (1976), Mussa (1976) serves as the point of departure for this study. The underlying arguments are that as the U.S. increases (decreases) the rate of money supply, the domestic nominal and real interest rates will decrease (increase) which encourages capital outflow (inflow) and the U.S. dollar become weaker (stronger). Foreign countries may pursue an exchange rate intervention policy in response to dramatically differing rates of domestic inflation caused by their own internal monetary policies. Thus, the determination of the bilateral exchange rate depends on both U.S. and foreign money market equilibrium.

In fact, Brazil and Argentina follow a policy of devaluing their currency against the U.S. dollar over time to maintain the purchasing power parity (PPP) and their competitive position of exports, Williams and Thompson (1984b). Members of the EC-12 may attempt to neutralize U.S. monetary policy as it affects the dollar exchange rate. Thus, the effects of U.S. monetary growth on the Brazil/Argentina and EC-12/Japan exchange rates should be different.

The equilibrium price and quantity are determined by the relative elasticities of exports and imports with respect to the exchange rate and world price. This suggests that a simple export demand equation will not be appropriate to estimate the competitive position of U.S. exports in the world market. Thus, a three-country monetary trade competition model is adopted.

Using the one-bond, one-good, and flexible-price assumptions, the exchange rate determination equation can be derived. The one-bond assumption implies perfect substitution between domestic and foreign bonds. The exchange rate determination is then shifted to the money markets. The domestic and foreign money market equilibrium conditions and the purchasing power parity can be expressed as:

(1) Money market equilibrium in the U.S.:

$$ms = p + \phi\, y - \tau\, i\ ,$$

(2) Money market equilibrium in the other country:

$$ms^* = p^* + \phi\, y^* - \tau\, i^*\ ,$$

(3) The purchasing power parity condition:

$$e = p^* - p\ ,$$

where the lower-case variables are in the logrithm form. All variables are defined such that ms is the nominal domestic money supply, p is the domestic price level, y is domestic real income, and i is the domestic short-term interest rate. The superscript * refers to the foreign country. The variable e is the logrithm of exchange rate defined as the amount of foreign currency per U.S. dollar. The parameters ϕ and τ are money demand elasticities. It is assumed that both domestic and foreign money demand elasticities are the same.

Solving equations (1) to (3) for the exchange rate, the exchange rate equation can be written as:

$$(4)\quad e = (ms^* - ms) - \phi\,(y^* - y) + \tau\,(i^* - i)\ .$$

A relatively high level of U.S. money supply depreciates the U.S. dollar, ceteris paribus, and vice versa. The sign of $(ms^* - ms)$ is expected to be positive. A relatively higher U.S. income level than that of foreign country will appreciate the U.S. dollar. A relatively higher level of U.S. interest rate than that of a foreign country decreases the domestic demand for U.S. assets (money) and depreciates the U.S. dollar.

Under the one-bond assumption, the interest difference between domestic and foreign countries becomes the expected appreciation of domestic currency. It can be expressed as:

$$(5)\quad i^* - i = E(\Delta e),$$

where E and Δ are signs of expectation and change, respectively. The expected appreciation is a consequence of the expected inflation differential:

$$(6)\quad E(\ e) = E(\Delta p^*) - E(\Delta p).$$

It is assumed that there is long-run secular inflation which may affect the money demand function and the expected appreciation of the domestic currency. The adjustment of the expected change in the exchange rate can also be expressed as:

$$(7) \quad E(\Delta e) = -\theta(e - \hat{e}) + [E(\Delta p^*) - E(\Delta p)],$$

where θ is the adjustment speed and $\hat{e}$ is the long-run equilibrium exchange rate.

Combining equation (5) and (6), the difference of the exchange rate from its equilibrium level becomes:

$$(8) \quad e - \hat{e} = -(1/\theta)[(i^* - E\Delta p^*) - (i - E\Delta p)].$$

Equations (8) and (6) are plugged into equation (4) to obtain the equilibrium exchange rate. This general monetary equation of exchange rate determination becomes:

$$(9) \quad \hat{e} = (m^* - m) - \phi\,(y^* - y) - (1/\theta)(i^* - i)$$
$$+ (\tau + 1/\theta)(E\Delta p^* - E\Delta p).$$

The relationships between the process of U.S. money supply and exchange rate movements are provided in Mussa(1976). The derivation can be used to convert the effects of U.S. money supply in equation (9) on the exchange rates to the effects of U.S. monetary growth on the exchange rates. The conversion formula between the elasticity of the exchange rate with respect to U.S. monetary growth and that with respect to U.S. money supply is derived in Appendix A.

The exchange rate model is linked to world prices and quantities by extending the trade competition model of Haley(1986) to incorporate Brazil and Argentina as an export competing country and the EC-12 and Japan as the importing country in the world market for soybeans and soybean products:

(10) Aggregate U.S. exports to EC-12 and Japan
$$USXP = ES^A(\ WP/CPIa;\ CAPa,\ Za\ ),$$
(11) Aggregate Brazil/Argentina exports to EC-12 and Japan
$$BAXP = ES^B(\ NE_b{*}WP/CPIb;\ CAPb,\ Zb\ ),$$
(12) Aggregate EC-12/Japan imports from the two exporting countries
$$EJMP = ED(\ NE_m{*}WP/CPI_m;\ Z_m\ ),$$
(13) Total exports of the U.S., Brazil, and Argentina
$$TXP = USXP + BAXP,$$
(14) The market equilibrium condition
$$TXP = ED,$$

where the nominal world price (WP) is the U.S. dollar import price per metric ton at Rotterdam for soybeans, at Decatur for soybean meal, and at European ports for soybean oil. U.S. soybean export capacity is defined as the total domestic supply over domestic demand and is represented by CAPa. The total domestic supply is the sum of domestic production and the carry-over stocks. Crushed soybeans are used as soybean demand for domestic crushing and the quantity of domestic use is adopted as domestic demand for soybean meal and oil. As the export capacity increases because of increased domestic production of soybeans or decreased domestic demand for crushing, U.S. excess supply to the world market will shift upward. The variables Z_a, Z_b, and Z_m represent vectors of other exogenous variables such as policy variables, real income levels, and competing product prices.

The nominal exchange rate (NE) is the currency price of another country relative to the U.S. dollar. The definition of the soybean export capacity of Brazil and Argentina is the same as that of the U.S. and is represented by CAPb.

The exchange rates and macroeconomic data are collected from the International Financial Statistics (IFS). The other data are collected from the Foreign Agricultural Trade of U.S. and Fats & Oil Situation. All data are on an annual basis for the period 1965 – 85. The data representing foreign countries' variables are calculated by weighting the index of the same variable X (1980=100) in each country with its trade share, i.e. $\Sigma\ w_i X_i$. Subscript i denotes the ith country and w is the import share of the ith country from the U.S. or export shares between Brazil and Argentina.

Model Implications

If the U.S. increases the rate of expansion of the money supply to lower the value of the dollar, this may increase U.S. export competition with Brazil and Argentina. As the U.S. dollar becomes weaker relative to the currency of an importing country, that country may increase imports. However, offsetting currency devaluations by Brazil and Argentina maintain or increase the current exchange rates and lessen the impact of U.S. monetary policy via the exchange rates. As the devaluation occurs, the soybean exports of Brazil and Argentina may retain some of their competitiveness with U.S. exports. The world price may be decreased or increased depending on the relative magnitude among the exchange rate and price effects of exports and imports. The level of exports of exporting countries will depend on the relative magnitude among the exchange rate and price effects of export competing and importing countries.

Similarly, the effects of a tight U.S. monetary policy on the equilibrium price and trade are complex. Brazil and Argentina may not need to devalue their currency to increase their competitive position in the world soybean market. As the world price increases, EC-12 and Japan decrease soybean imports if the exchange rate does not offset the increased world price. Again, the effects on equilibrium price and quantity depend on the elasticities of soybean exports and imports with respect to local currency price.

Trade Elasticities

The effects of U.S. monetary policy on the world price and quantity of U.S. soybean exports can be demonstrated in elasticity form, (Chambers 1981). Extending this model to include two export countries and a set of importing countries, the elasticity of the world price with respect to U.S. money supply can be stated as:

$$(15)\quad E_{M}^{WP} = \frac{[X]}{E_{NE_m*WP/CPI_m}^{ED} - F_a * E_{WP/CPI_a}^{ES^A} - F_b * E_{NE_b*WP/CPIb}^{ES^B}},$$

where the numerator [X] equals:

$$F_a * E_{WP/CPIa}^{ES^A} E_{M}^{1/CPIa} + F_b * E_{NE_b*WP/CPIb}^{ES^B} E_{M}^{NE_b} - E_{NE_m*WP/CPI_m}^{ED} E_{M}^{NE_m},$$

and the elasticity of U.S. soybean exports with respect to its money supply becomes:

$$(16)\quad E_{M}^{ES^A} = \frac{[Y]}{F_a},$$ and where the numerator [Y] equals:

$$E_{NE_m*WP/CPI_m}^{ED} [\, E_{M}^{NE_m} + E_{M}^{WP} \,] - F_b * E_{NE_b*WP/CPIb}^{ES^B} [\, E_{M}^{NE_b} + E_{M}^{WP} \,],$$

where E_i^j represents the elasticity of variable j with respect to variable i. The U.S. monetary growth rate is represented by M. F_a and F_b are the shares of U.S., Brazil and Argentina soybean exports. The elasticity of U.S. exports with respect to the export capacity is not included in equation (15) because there is no direct linkage between the export capacity and the monetary growth rate. The sign of the numerator and denominator of (15) is negative. The magnitudes of these relevant elasticities must be determined empirically. The sign of E_M^{ESA} depends on the relative magnitudes of the elasticities of the world price and exchange rates with respect to U.S. monetary growth. This must also be determined empirically.

Statistical Results

Exchange Rate Equation

The theory of the monetary approach to the exchange rate determination helps to identify the elasticity of the exchange rates with respect to U.S. money supply. Ordinary least squares is applied to estimate the log-linear exchange rate equations. Only the income levels (y's) are in real terms. Annual data are used over the period 1972 to 1985, when the U.S. flexible exchange rate system was operative. Only the exchange rates of soybeans and soybean meal are estimated due to lack of reliable data for the soybean oil trade. The estimated exchange rate equations from Brazil/Argentina and EC/Japan are shown in Table 3.

The estimated model is slightly different from the derived exchange rate in equation (9). It is assumed that domestic and foreign monetary elasticities with respect to real income and the inflation rate are different. This is a relaxation of a former assumption in the derivation of equation (9).

U.S. money supply has positive and negative effects on the exchange rate faced by importers and competing exporters, respectively. The magnitude of the effect of U.S. money supply on the exchange rate of EC-12 and Japan is much greater than on the exchange rate of Brazil and Argentina. Using the formula derived in Appendix A., the elasticities of the trade-weighted exchange rates with respect to U.S. monetary growth are negative in sign for EC-12 and Japan and positive in sign for Brazil and Argentina. As U.S. monetary growth increases, the trade value of the dollar decreases in the EC-12/Japan exchange market and increases in the Brazil/Argentina exchange market. This suggests that U.S. monetary intervention serves to lower the EC-12/Japan exchange rate but not the Brazil/Argentina exchange rate.

U.S. income level affects the EC-12/Japan exchange rate positively with statistical significance in the soybean meal market. The income levels in EC-12 and Japan positively impact its exchange rate with statistical significance. The U.S. interest rate is positively related to the EC-12/Japan exchange rate in both markets. The signs of the interest rates of the countries other than the U.S. are negative. The U.S. inflation rate affects the exchange rate negatively while EC-12/Japan inflation rate affects the exchange rate positively in both soybean and soybean meal markets.

Soybean Trade Equations

The trade-competition model is estimated empirically by using annual data from 1965 to 1985 for soybeans and soybean meal. The estimated exchange rates from 1972 to 1985 in Table 3 combined with the calculated exchange rates from 1965 to 1971 are used for the estimation of the trade model. The model is then estimated in log-linear form using the seemingly unrelated regression technique. The results are presented in Table 4. The figures in parenthesis are t-statistics.

In the world market of soybeans, the real world price is positive in sign for U.S. exports. The U.S. export capacity is statistically insignificant which implies that the export capacity is not a constraint for U.S. exports of soybeans. The lagged dependent variable is positively related to U.S. soybean exports which implies that actual U.S. soybean exports are adjusted from the expected amount of exports over time. This adjustment is due to the time constraint of soybean production.

In Brazil and Argentina, the world soybean price in real local currency is positively related to their exports of soybeans. As the U.S. dollar appreciates, Brazil and Argentina increase their competitiveness relative to U.S. soybean exports. The Brazil/Argentina export capacity is positively related to its soybean exports. As the soybean crushing industry grows, domestic demand for soybeans is increased. As a result, the export capacity decreases and the exports of soybeans decline which is consistent with the research of Williams and Thompson (1984a) on the Brazilian soybean industry. The lagged

Brazil/Argentina soybean exports are positively related to current soybean exports which also implies that Brazil/Argentina soybean exports are constrained by the time of production. The dummy variable is positively related to exports which represents that Brazil and Argentina have had the policy of encouraging soybean production since 1972.

In EC-12 and Japan, the world price in real local currency is negatively related to their imports of soybeans. As the U.S. decreases monetary growth and pushes up the value of the dollar, the real world price faced by EC-12/Japan soybean importers increases. Thus, EC-12/Japan soybean imports decline. Rapeseed is a primary import substitute for soybeans and it's price is positively related to soybean imports. As the price of rapeseed increases, EC-12 countries would prefer soybeans as an import substitute. The real income level has a positive sign as expected. The increasing real income in EC-12 and Japan increases the imports of soybeans.

In the soybean meal market, U.S. soybean meal exports respond to the world price positively. The soybean meal export capacity is also positively related to exports in the U.S. and is very elastic. This suggests that U.S. soybean meal exports are very sensitive to the relative level of domestic production and crushing capacity. If domestic demand for high-protein input increases at a rate larger than the increase of crushed soybeans, U.S. soybean meal exports decrease to satisfy domestic need. It also implies that U.S. crushing capacity has not reached a sufficient level. The soybean embargo in 1973 decreased U.S. soybean meal exports and is captured by the coefficient of the dummy variable D73.

In Brazil and Argentina, soybean meal exports response to the world price in real local currency is statistically insignificant. The policy of encouraging meal exports is the driving force of this lack of response to price level. The export capacity is positive in sign as expected but the magnitude is a lot smaller than that in the U.S. equation. This is also related to the policy of encouraging the exports of processed products rather than the exports of raw soybeans in these two countries. The policies for economic growth of Brazil and Argentina have further increased their meal exports since 1972 which is captured by the dummy variable D72.

In EC-12 and Japan, the soybean meal imports will increase as the trade value of the dollar decreases which is similar to the imports of soybeans. The cottonseed meal is one alternative substitute from soybean meal in EC-12. However, soybean meal dominates the EC-12 demand and the price of cottonseed meal is not statistically significant in the EC-12/Japan import equation. The income level is positively related to the soybean meal imports. The U.S. soybean embargo in 1973 decreased the imports of soybean meal as is reflected by the coefficient on D73.

Calculated Trade Elasticities

These estimated results can be used to calculate the elasticities of the world price, U.S. and Brazil/Argentina exports, and EC-12/Japan imports with respect to the U.S. monetary growth rate, see Appendix B. These estimates are obtained by setting those variables in Table 3 and Table 4 with statistically insignificant coefficients to zero which implies that these variables have no long term influence on world soybean trade. Given this, the calculated elasticities are shown in Table 5. Figures in parenthesis are the average market shares of exporting countries.

In the world soybean market, the elasticity of the world price with respect to U.S. monetary growth is positive and close to unity. As the U.S. increases the monetary growth rate, the domestic price level increases and the trade value of the dollar relative to other currencies decreases. The increased U.S. consumer price level decreases U.S. soybean exports in the short run. The value of the dollar remains high relative to the value of Brazil/Argentina currency. Brazil/Argentina soybean exports increase which implies that Brazil and Argentina maintain the competitiveness over U.S. soybean exports. However, the market share of Brazil/Argentina soybean exports in the EC-12/Japan market is so low that their export competition is minor and has little impact on the level of world price. The value of the dollar is lowered in EC-12/Japan exchange rate which increases EC-12/Japan soybean imports. The increased import demand dominates the increased aggregate export supply. As a result, the world soybean price increases in the long run as the U.S. monetary growth rate increases and vice versa. The estimated elasticity of the world price with respect to U.S. monetary growth is then used to calculate the remaining trade elasticities reported in Table 5.

The elasticity of U.S. soybean exports is positive and very inelastic. Both Brazil/Argentina exports and EC-12/Japan imports of soybeans are increased by an increase in U.S. monetary growth rate. The magnitude of the increased EC-12/Japan imports dominates that of the increased Brazil/Argentina exports. As a result, an increase of U.S. monetary growth will increase U.S. export share in the world soybean market but the magnitude is small.

The elasticity of Brazil/Argentina soybean exports with respect to U.S. monetary growth rate is positive and close to unity. The decreased U.S. soybean exports due to decreased real price from an expansionary U.S. monetary policy is small in magnitude. Thus, the increased Brazil/Argentina exports satisfies most of the increased demand for soybeans in EC-12 and Japan. Thus, the elasticity of Brazil/Argentina soybean exports with respect to U.S. monetary growth rate is close to unity due to its low market share.

By taking into account the market shares, the actual responses of both Brazil/Argentina and U.S. soybean exports to U.S. monetary growth rate are very inelastic. But, the magnitude of U.S. response is lower than the magnitude of Brazil/Argentina response. Thus, an expansionary U.S. monetary policy does not serve to increase the competitiveness of U.S. soybean exports.

The elasticity of EC-12/Japan soybean imports with respect to the U.S. monetary growth rate is positive but inelastic. This elasticity is simply the weighted average of the two export elasticities. Since the actual response of both U.S. and Brazil/Argentina soybean exports to U.S. monetary growth rate are very inelastic, the import elasticity becomes inelastic.

In the soybean meal market, the elasticity of the world price with respect to U.S. monetary growth is positive and elastic. As U.S. monetary growth increases, U.S. domestic price level increases. The trade value of the dollar declines relative to EC-12/Japan currency and increases relative to Brazil/Argentina currency. The increased U.S. domestic price level decreases U.S. soybean meal exports. The increased Brazil/Argentina exchange rate may increase Brazil/Argentina soybean meal exports. However, Brazil/Argentina soybean meal exports do not respond to the world price in local currency. Thus, the increased U.S. monetary growth rate has no impact on Brazil/Argentina soybean meal exports. The decreased EC-12/Japan exchange rate increases EC-12/Japan soybean meal imports. The low U.S. market share and price elasticity generates a minor effect on the decreased U.S. exports on the world soybean meal price. The increased soybean meal demand becomes the most important factor to affect the world price. As a result, the world price of soybean meal increases. The estimated elasticity of the world price of soybean meal with respect to U.S. monetary policy is then used in the calculation of the other elasticities in Table 5.

The elasticity of U.S. soybean meal exports with respect to U.S. monetary growth rate is positive and very inelastic. Since Brazil/Argentina soybean meal exports do not respond to real world price, U.S. soybean meal exports must satisfy the increased EC-12/Japan soybean meal imports. The low price elasticity of EC-12/Japan soybean meal imports lowers the magnitude of the import demand. Thus, U.S. soybean meal exports are increased by a minor percentage.

The elasticity of Brazil/Argentina soybean meal exports with respect to U.S. monetary growth rate is zero. This is the result of the lack of response of Brazil/Argentina soybean meal exports to the world price in real local currency. Thus, U.S. monetary expansion does not serve to decrease the competitiveness of U.S. soybean meal exports.

The elasticity of EC-12/Japan soybean meal exports with respect to U.S. monetary growth rate is positive but very inelastic. The low price elasticities of U.S. exports and EC-12/Japan imports generate this result. It also implies that U.S. monetary policy does not have a great impact on exports and imports of soybean meal.

The results imply that U.S. monetary policy does serve to increase the competitiveness of U.S. soybean meal exports but not soybean exports. This comes about through the effect of monetary policy on the exchange rate. The primary effects of U.S. monetary policy are on the world prices. Based on the calculated elasticities reported in this study, U.S. monetary expansion may serve to increase market share of U.S. soybean meal exports but the magnitude will be low. Also, U.S. monetary expansion may not serve to increase market share of U.S. soybean exports.

Conclusions

This paper investigates the macroeconomic linkage of soybean trade competition between the U.S., Brazil and Argentina in the EC-12 and Japan importing market. It is argued that U.S. monetary growth may have important impacts on the competitive position of U.S. soybean exports through the exchange rates. Two relationships are investigated: i) the effects of U.S. monetary growth on the agricultural trade-weighted exchange rate, and ii) the responsiveness of agricultural commodity prices and U.S. exports to exchange rate movements. Finally, the competitiveness of U.S. exports of soybeans and soybean meal under U.S.

monetary influence are investigated.

Export competing countries such as Brazil and Argentina follow a trade policy of devaluing their currency against the U.S. dollar in response to their domestic rate of inflation. The importing countries of EC-12 and Japan have restrictive exchange rate policies designed to neutralize the effects of U.S. monetary policy on world trade. The estimated monetary model proves that U.S. monetary expansion does not lower the value of the dollar against the value of Brazil/Argentina currency. U.S. monetary expansion, however, lowers the value of the dollar against the value of EC-12/Japan currency. This result casts doubt on the possibility of increasing U.S. export competitiveness through U.S. monetary expansion.

The specification of the trade model provides a reasonable explanation of the structural and policy differentials among the trading countries. In the world soybean market, U.S. and Brazil/Argentina exports respond positively to the world price in real local currency. EC-12/Japan imports respond negatively to the world price in real local currency. U.S. exports are not constrained by its export capacity while Brazil/Argentina exports are constrained by their export capacity. This difference is due to the large capacity of U.S. production and the Brazil/Argentina policy of encouraging exports of soybean products rather than raw soybeans. The EC-12/Japan imports are mainly driven by the world price in real local currency and domestic real income.

In the world soybean meal market, U.S. exports respond to the real world price positively while Brazil/Argentina exports do not respond to price. The EC-12/Japan imports respond to the world price in real local currency negatively as expected. Both U.S. and Brazil/Argentina exports of soybean meal are constrained by their own export capacity. The magnitude of the U.S. capacity elasticity is significantly larger than the Brazil/Argentina capacity elasticity. This suggests that increasing U.S. crushing capacity may stimulate U.S. soybean meal exports greatly while Brazil and Argentina can slightly increase their meal exports through increased crushing capacity. This result follows from the fact that U.S. crushing capacity is not sufficient and Brazil/Argentina policies encourage meal crushing and domestic feed use. The EC-12/Japan soybean meal imports are mainly driven by domestic real income level.

Empirical results presented in this paper further suggest that the soybean export competing country and importing country responses to the exchange rates are statistically significant. The estimation provides evidence of a strong link between U.S. monetary growth rate and the trade-weighted exchange rates and that between trade and the exchange rates. As a result, the link between U.S. monetary growth rate and soybean prices and trade quantities is apparent.

A weak dollar increases imports of soybeans significantly which serves to increase the equilibrium world price and increase both U.S. and Brazil/Argentina exports in the long run. However, the increase in U.S. soybean exports is lower in magnitude than the increase in Brazil/Argentina soybean exports. Total world soybean exports are increased by expansionary U.S. monetary policy. For this reason the U.S. market share of world soybean trade decreases. Thus, U.S. monetary expansion does not serve to increase the competitiveness of U.S. soybean exports.

A weak dollar also increases imports of soybean meal which serves to increase the equilibrium world soybean meal price and U.S. soybean meal exports in the long run. The lack of Brazil/Argentina response to real world price creates an opportunity for the U.S. to increase soybean meal exports with an expansion of U.S. monetary growth. Thus, U.S. monetary expansion serves to increase the competitiveness of U.S. soybean meal exports. However, the increased U.S. market share is small in magnitude.

The empirical results may suggest some policy implications for U.S. soybean exports. U.S. monetary expansion may not be the solution to increase U.S. export market shares in EC-12/Japan market. Since U.S. soybean meal exports are sensitive to domestic crushing capacity which is not sufficiently built, increasing crushing capacity may be one possible solution. Trade negotiation among export competitors to decrease trade subsidies may be another solution. It is also important for the U.S. to expand exports to other markets around the world.

The empirical results may also suggest some policy implications for the U.S. domestic economy. Since expansionary monetary policy may drive the world price up, U.S. soybean and soybean meal exports are increased. The increased soybean and soybean meal exports will lower domestic supply and increase domestic soybean and soybean meal prices. Other agricultural sectors may be affected by the increased price of this high-protein crops. The industry which depends the most on soybean meal will have to figure out ways to reduce costs in order to maintain competitiveness. In such a case, the substitutes for soybean meal may provide an opportunity to increase domestic sales.

A number of limitations emerge from this study. The linkage between U.S. monetary policy and the exchange rate may be extended to include price expectation variables. In this paper, the monetary model assumes no bond market effects on the equilibrium exchange rate. A more realistic approach would be to allow for the impacts of bond markets on the equilibrium level if the data for bond markets were available.

In addition, the monetary policy may have impacts on domestic soybean supply and demand schedules. These impacts are assumed away from this study. To include this possible impacts in the study may need a complete macroeconomic and trade structural model. Since soybean sector does not represent a major portion of domestic gross national income (GNP), the assumption that monetary policy has little impact on soybean sector may be appropriate.

Table 1. Export Shares of Soybeans and By-Products: U.S., Brazil, Argentina, and Rest of World (ROW), Marketing Year, 1965-1985. * (%)

	Soybean Exports			Soymeal Exports			Soyoil Exports		
Year	U.S.	Brazil & Argentina	Row	U.S.	Brazil & Argentina	Row	U.S.	Brazil & Argentina	ROW
1965	88.18	1.15	10.68	65.36	3.72	30.93	78.05	0.00	21.95
1966	89.83	1.59	8.57	66.78	5.23	27.99	72.37	0.00	27.63
1967	87.62	3.75	8.63	68.90	3.57	27.53	72.19	0.00	27.81
1968	90.77	0.83	8.41	67.98	6.07	25.95	69.48	0.00	30.52
1969	89.97	3.57	6.46	64.62	7.25	28.12	57.75	0.00	42.25
1970	93.65	2.31	4.04	63.91	10.13	25.96	58.18	0.27	41.55
1971	93.88	1.83	4.29	61.56	14.73	23.71	57.88	0.51	41.61
1972	87.90	7.93	4.18	50.12	21.86	28.02	52.35	3.14	44.51
1973	84.50	11.58	3.92	52.77	17.01	30.22	42.57	9.15	48.29
1974	81.13	15.82	3.05	49.99	23.92	26.09	44.47	3.35	52.19
1975	73.49	22.57	3.94	40.42	37.40	22.18	30.16	22.01	47.83
1976	78.56	17.88	3.55	41.74	38.71	19.55	25.94	29.10	44.96
1977	80.20	16.74	3.06	34.73	47.47	17.80	32.53	28.92	38.55
1978	85.33	11.76	2.91	38.16	39.70	22.14	34.74	21.63	43.63
1979	81.58	13.85	4.57	40.06	35.39	24.55	36.37	19.27	44.37
1980	81.95	14.65	3.39	38.17	38.26	23.57	34.55	25.40	40.05
1981	80.33	15.05	4.62	30.95	46.04	23.01	21.60	37.83	40.57
1982	85.58	9.98	4.45	30.23	43.57	26.19	25.91	30.06	44.03
1983	86.37	9.31	4.33	27.72	41.94	30.34	24.38	33.07	42.55
1984	76.86	17.92	5.22	22.18	47.23	30.59	20.79	35.81	43.40
1985	65.42	25.76	8.82	20.09	50.57	29.34	20.66	40.48	38.86

* Source: U.S. Department of Agriculture.

Table 2. Export Shares of U.S., Brazil and Argentina in the EC-12 and Japan Market. (%) *

	Soybeans		Soymeal		Soyoil	
Year	U.S.	Brazil & Argentina	U.S.	Brazil & Argentina	U.S.	Brazil & Argentina
1965	98.39	1.61	93.39	6.61	na	na
1966	97.81	2.19	90.65	9.35	na	na
1967	95.06	4.94	93.60	6.40	na	na
1968	98.98	1.02	89.87	10.13	na	na
1969	95.31	4.69	87.93	12.07	na	na
1970	96.84	3.16	81.67	18.33	77.42	22.58
1971	97.74	2.26	75.22	24.78	44.00	56.00
1972	90.33	9.67	63.12	36.88	1.66	98.34
1973	85.27	14.73	68.88	31.12	10.73	89.27
1974	79.79	20.21	58.49	41.51	48.00	52.00
1975	74.96	25.04	43.06	56.94	3.34	96.66
1976	76.18	23.82	43.08	56.92	2.26	97.74
1977	79.68	20.32	31.92	68.08	1.24	98.76
1978	85.21	14.79	38.71	61.29	1.82	98.18
1979	80.72	19.28	38.97	61.03	0.97	99.03
1980	78.99	21.01	36.51	63.49	0.00	100.00
1981	82.59	17.41	29.51	70.49	1.86	98.14
1982	89.10	10.90	31.32	68.68	2.84	97.16
1983	85.36	14.64	29.54	70.46	0.27	99.73
1984	74.02	25.98	14.94	85.06	0.33	99.67
1985	64.93	35.07	15.69	84.31	0.15	99.85

Source: U.S. Department of Agriculture and Foreign Agricultural Trade of the U.S.
* na represents data not available.
Brazil/Argentina data are proxies.

Table 3. Estimated Exchange Rate Equations. (1972-1985) /a

Products & Countries	Constant	$(m^* - m)$	y^*	y	$(i^* - i)$	$E\ \Delta P^*$	$E\ \Delta P$	R**2	d.f.	D-W
I. Soybeans										
a. EC-12 & Japan	-19.752 (-2.68)	-2.950/c (-4.09)/b	3.249 (1.65)	0.671 (0.39)	-0.004 (-1.33)	0.062 (3.16)	-0.021 (-1.43)	0.83	7	2.13
b. Brazil & Argentina	6.729 (17.20)	1.182/c (37.15)	0.051 (0.43)	---	---	---	-0.041 (-1.67)	0.996	10	1.68
II. Soymeal										
a. EC-12 & Japan	-38.396 (-3.80)	-3.133/c (-3.57)	---	4.839 (4.36)	-0.004 (-1.11)	0.085 (2.64)	-0.018 (-0.76)	0.80	8	1.77
b. Brazil & Argentina	7.402 (14.98)	1.174/c (39.94)	-0.137 (-0.95)	---	---	---	-0.039 (-1.74)	0.996	10	0.95

a : The dependent variable is the log of foreign currency/dollar. The variables are in logrithm forms except the interest rates and inflation rates. The variables are defined as m^* : EC-12/Japan or Brazil/Argentina level of money supply (M1), IFS; m : U.S. level of money supply (M1), IFS; y^* : EC-12/Japan or Brazil/Argentina real gross national income (GNP), IFS; y : U.S. real gross national income, IFS; $E\Delta p^*$: lagged rate of change in EC-12/Japan or Brazil/Argentina consumer price index, IFS; $E\Delta p$: lagged rate of change in U.S. consumer price index, IFS; i^* : nominal EC-12/Japan or Brazil/Argentina discount rate, IFS; i : U.S. 6-month T-Bill rate, IFS.
b : Figures in parenthesis are t-statistics.
c : Significant level is 0.99.
--- : Excluded based on multicolinearity considerations.

Table 4. Estimated Soybean Trade Equations, 1965-1985. /a

USXP, BAXP, and EJMP	Constant	WP	CAP	Other Variables: LXP	SWP	Real GNP	D72	D73	R**2	d.f.	D-W
I. Soybeans											
a. U.S.	2.657 (2.83)/b	0.229** (2.26)	0.129 (0.65)	0.818 (13.63)				---	0.912	16	2.07
b. Brazil & Argentina	4.918 (2.68)	0.686*** (2.64)	1.130 (1.94)	0.237 (2.03)			1.963 (6.42)		0.926	15	2.14
c. EC-12 & Japan	20.356 (28.06)	-0.701*** (-5.01)			0.411 (4.60)	1.697 (14.73)		---	0.978	16	1.42
II. Soymeal											
a. U.S.	13.035 (74.52)	0.172** (2.31)	5.745 (9.85)	---				-0.167 (-1.48)	0.816	16	1.48
b. Brazil & Argentina	13.573 (3.40)	-0.298 (-0.37)	0.389 (1.10)	---			2.893 (6.62)		0.793	16	1.04
c. EC-12 & Japan	17.256 (23.04)	-0.173* (-1.17)			-0.108 (-0.80)	3.415 (19.29)		-0.177 (-1.72)	0.958	15	1.12

a : The model is estimated using Seemingly Unrelated Regression Estimation (SURE). The variables are in logrithm forms and are defined as USXP : quantity of U.S. exports of soybeans or soybean meal to EC-12 and Japan (marketing year), FATUS; BAXP : quantity of Brazil/Argentina exports of soybeans or soybean meal to EC-12 and Japan (marketing year), a proxy data, ATY; EJMP : quantity of EC-12/Japan imports of soybeans or soybean meal from the U.S., Brazil, Argentina (marketing year), FATUS and ATY; WP : real world price of soybeans at Decatur or soybean meal at European ports deflated by consumer price index, this world price is multiplied by the exchange rate to become local currency, ATY; CAP : export capacity in exporting country of soybeans or soybean meal calculated by dividing total domestic supply, including stocks with total domestic use, USDA; LXP : lagged dependent variable; SWP : real price of substitutable product of soybeans or soybean meal, ATY; GNP : real gross national income of EC-12 and Japan, IFS; D72 : dummy variable equals 0 prior to 1972 and 1 after 1971 for the Brazil/Argentina equations; D73 : dummy variable equals 1 in 1973 and 0 otherwise for U.S. and EC-12/Japan equations;

b : Figures in parentheses are t statistics.

--- : Excluded based on multicolinearity consideration.

*** : Significant level is 0.99 .

** : Significant level is 0.95 .

* : Significant level is 0.85 .

Appendix A

By definition, the elasticity of the exchange rate (NE) with respect to U.S. monetary growth rate (M) can be expressed in the form of:

$$E^{NE}_{M} = \frac{dNE_t}{d\left(\dfrac{MS_t - MS_{t-1}}{MS_{t-1}}\right)} \; \frac{\dfrac{MS_t - MS_{t-1}}{MS_{t-1}}}{NE_t} .$$

Where MS represents the level of U.S. money supply. Subscripts denote current and lagged time and d is the sign of differentiation. Taking total differentiation on the denominator of the first term in the above equation, the above equation becomes:

$$E^{NE}_{M} = \frac{dNE_t}{\dfrac{MS_{t-1}dMS_t - MS_t dMS_{t-1}}{MS_{t-1}^{2}}} \; \frac{\dfrac{MS_t - MS_{t-1}}{MS_{t-1}}}{NE_t} .$$

Assuming that the process of U.S. money supply follows a first-order autocorrelation model, the relationship between current and lagged level of money supply can be expressed as:

$$dMS_t = \delta \; dMS_{t-1} .$$

The impact of U.S. money supply process on exchange rate are discussed in Mussa (1976) and Meese and Rogoff (1983). Substituting the above equation into the elasticity equation will generate the following equation:

$$E^{NE}_{M} = \frac{dNE}{(MS_t - 1/\delta \; MS_t) \; dMS_t} \; \frac{MS_{t-1}(MS_t - MS_{t-1})}{NE} .$$

Converting the right hand side of the above equation to elasticity form, conversion formula comprising the elasticity of exchange rate with respect to U.S. money supply and that with respect to U.S. monetary growth rate is obtained as:

$$E^{NE}_{M} = E^{NE}_{MS} \cdot \frac{MS_{t-1}}{MS_t} \; \frac{(MS_t - MS_{t-1})}{(MS_{t-1} - 1/\delta \; MS_t)} .$$

The ratio of lagged money supply to current money supply can be calculated using the mean values.

To show the conversion formula in a simpler way, the autocorrelation coefficient must be obtained. Using the data from 1965 to 1985, the first-order autoregression is obtained:

$$MS_t = \underset{(0.0057)}{1.077} * MS_{t-1}\ , \quad R**2 = 0.996, \quad D\text{-}W = 1.54, \quad d.f. = 19.$$

Where the figure in parenthesis is the standard error. This low standard error implies that the process of U.S. money supply is not a random walk.

Using the calculated mean value of U.S. money supply and the above autocorrelation coefficient, the conversion formula becomes:

$$E_{M}^{NE} = (-0.434) * E_{MS}^{NE} \ .$$

Appendix B

The elasticities of the world price and U.S. soybean exports are obtained as follows. For the elasticity from equation (15):

$$[X] = 0.83\ (0.229)(-0.57) + 0.17\ (0.686)(-1.182)(-0.434) - (-0.701)(2.95)(-0.434) = -0.94601\ .$$

The related denominator is: -0.701 - 0.83 (0.229) - 0.17 (0.686) which equals -1.00769. Thus, the elasticity of world soybean price with respect to U.S. monetary growth becomes 0.939.

The figure for the elasticity of 1/CPIa with respect to U.S. monetary growth rate is -0.57. This figure is obtained from the direct estimation of the following log-linear model:

$$1/CPI_a = \underset{(-8.34)}{-3.18} - \underset{(-2.76)}{0.57} * M\ , \quad R**2 = 0.29, \quad D\text{-}W = 0.65, \quad d.f. = 19.$$

The coefficient of M becomes the elasticity of the reciprocal of U.S. price level with respect to U.S. monetary growth rate.

For the elasticity from equation (16):

$$[Y] = -0.701\ [(2.95)(-0.434) + 0.939] - 0.17(0.686)\ [(-1.182)(-0.434) + 0.939] = 0.0699\ .$$

The related denominator is 0.83 . Thus, the elasticity of U.S. soybean exports with respect to U.S. monetary growth rate becomes 0.084. The number -0.434 is to convert the elasticity of the exchange rate with respect to U.S. money supply into that with respect to U.S. monetary growth. The other elasticities can be obtained by using the same technique.

References

Batten, Dallas S. and Michael T. Belongia. "Money Growth, Exchange Rates, and Agricultural Trade." in United States Farm Policy in a World Dimension, Nov. 10-11, 1983, Special Report 305, Agricultural Experiment Station, University of Missouri-Columbia, pp. 28-36.

____________________. "Monetary Policy, Real Exchange Rates and U.S. Agricultural Exports." Prepared for presentation at the Ninety-Eight Meeting of the American Economic Association, New York, December 28-30, 1985.

Chambers, Robert G. and Richard E. Just. "Interrelationships Between Monetary Instruments and Agricultural Commodity Trade." American Journal of Agricultural Economics, Vol. 63, No. 5, December 1981, pp. 934-41.

____________________. " An Investigation of the Effect of Monetary Factors on Agriculture." Journal of Monetary Economics, Vol. 9, No. 2, March 1982, pp. 235-47.

Collins, Keith J., Williams H. Meyers, and Maury E. Bredahl. "Multiple Exchange Rate Changes and U.S. Agricultural Commodity Prices." American Journal of Agricultural Economics, Vol. 62, November 1980, pp. 656-65.

Frenkel, Jacob A. "A Monetary Approach to the Exchange Rate: Doctrinal Aspects and Empirical Evidence." Scandinavian Journal of Economics, Vol. 78, No. 2, May 1976, pp. 200-24,

Haley, L. Stephen. "The Value of the Dollar and Competitiveness of U.S. Wheat Exports." United States Department of Agriculture, ERS, International Economic Division, July 1986.

International Monetary Fund, International Financial Statistics, Various issues.

Jabara, L. Cathy and Nancy E. Schwartz. "Flexible Exchange Rates and Commodity Price Changes: The case of Japan." American Journal of Agricultural Economics, Vol. 69, No. 3, August 1987, pp. 580-590.

Longmire, J. and A. Morey, "Strong Dollar Dampens Demand for U.S. Farm Exports." U.S. Department of Agriculture, ERS, Foreign Agricultural Economic Report #193, December 1983.

Meese, Richard, and Kenneth Rogoff, "Empirical Exchange Rate Models of the Seventies: Do They Fit Out of Sample?" Journal of International Economics, Vol. 14, February 1983, pp. 3-24.

Mussa, Michael. "The Exchange Rate, the Balance of Payments, and Monetary and Fiscal Policy under a Regime of Controlled Floating." Scandinavian Journal of Economics, Vol. 78, No. 2, May 1976, pp. 229-48.

Schuh, G. Edward. "The Exchange Rate and U.S. Agriculture." American Journal of Agricultural Economics, Feb. 1974, pp. 1-13.

U.S. Department of Agriculture, Fats and Oil Situation, Various issues.

Williams, W. Gary and Robert L. Thompson, "The Brazilian Soybean Industry, Economic Structure and Policy Interventions", International Economics Division, Economic Research Service, U.S. Department of Agriculture, Foreign Agricultural Economic Report No. 200, October 1984a.

______________________________, "Brazilian Soybean Policy: The International Effects of Intervention." American Journal of Agricultural Economics, Vol. 66, No. 4, November 1984b.